

### 3. Study Area Existing Conditions

#### 3.1 Natural Environment

The Thames River, which flows through the City of London, is one of the largest river systems in Southern Ontario. The North and South Branches of the Thames River converge near the City's downtown area at a location commonly referred to as "the Forks". The Thames River was recognized as a Canadian Heritage River in 2000, and is acknowledged to be a river of great natural, cultural, and recreational importance. The river plays a significant role in the lives of people in the City of London (Dillon et al., 2011).

The Thames River watershed lies within in the Carolinian Zone (Eco Region 7E), which extends through southern Ontario from Toronto to Windsor. This ecozone is the most populated zone in Canada, containing 25% of the Canadian population in only 0.25 percent of the Canada's land mass. The Carolinian Zone hosts more species than any other region in Canada (Carolinian Canada Coalition, 2016), including many endangered and threatened species. Ongoing conservation measures, and expanding urban populations and development makes this zone unique for governance and regulatory agencies.

An overview and description of the natural environment conditions in the One River Study Area are detailed in the River Characterization (Appendix A-1) and Natural Heritage Summary (Appendix A-2) reports. Information for these reports was gathered from previous environmental studies completed by the City, UTRCA and other consultants. To supplement existing data for the One River EA, localized environmental field programs focusing on the river and aquatic environment were completed in 2017 and 2018. These field programs included fisheries sampling, aquatic habitat mapping, bathymetry surveys and geomorphic assessments. Findings from these two documents describe the current conditions of the Thames River and riparian corridor.

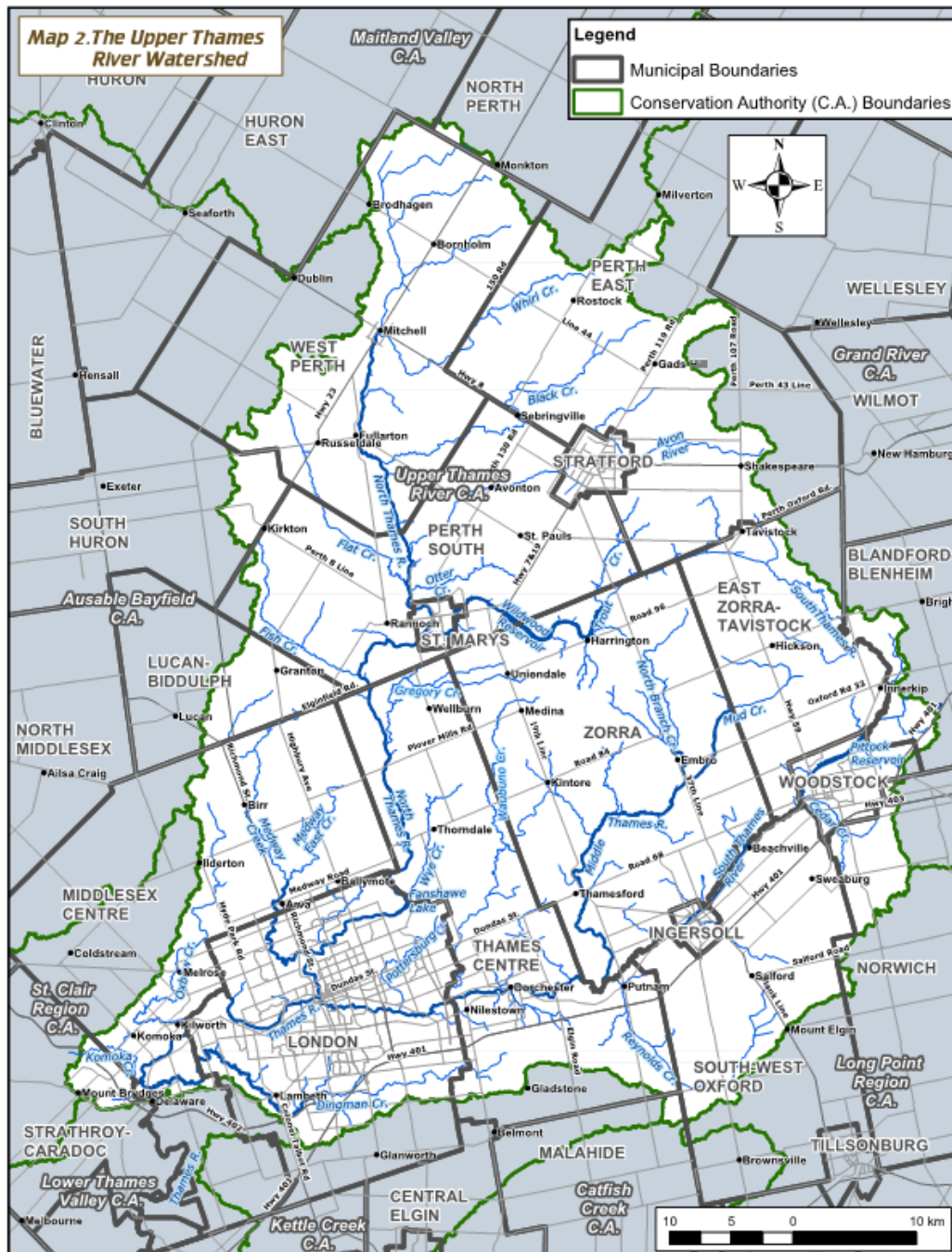
##### 3.1.1 Watershed Description

The Thames River in the Study area drains over 3,000 km<sup>2</sup> of upstream area. In the Upper Thames watershed there are three main rivers flowing toward the City of London: North Thames, Middle Thames, and South Thames (Figure 3-1). Several other large tributaries contribute flow to these main stems including Medway Creek. The physiography of the watershed is characterized by till plains, till moraine, and alluvial features around river valleys (UTRCA, 1998). The area's climate and soils are suitable for agriculture, and the watershed has been extensively farmed over the last 200 years (UTRCA, 1998). Over 75 percent of the Upper Thames watershed land use is classified as agriculture, with 14 percent considered natural vegetation and 8 percent urban (UTRCA, 2017a). The large agricultural portion of the watershed combined with the urban portions leads to 58 percent of the watershed being artificially drained through tile drainage and/or urban infrastructure. Within the One river study area, the land use is largely urbanized (80 percent), and runoff is conveyed to the river through storm sewers and outfalls (UTRCA, 2017a).

In general, the Upper Thames River is set in a confined river valley with steep bluffs and slopes typically alternating with shallow terracing on the opposite bank (UTRCA, 1998). The channel gradient (slope of the river) is low and glaciofluvial deposits (sediment deposited by glacial ice and redeposited by meltwater) underlay the majority of the valley. This low energy (from low slope) and confined setting has limited the river's ability to migrate or shift over time. Review of historical photographs of the Thames River show that besides some local instances such as the oxbow cutoff at the Coves, the river has not undergone any significant migrations in the last century (UTRCA, 1998).

Forest conditions in the Upper Thames watershed are poor, covering only 11 percent of the watershed, where the Environment and Climate Change Canada (ECCC) recommendation for a sustainable watershed is 30 percent (UTRCA, 2017c). Similarly, wetlands make up less than 5 percent of the upstream watershed, where ECCC recommends at least 10 percent coverage for a healthy ecosystem (UTRCA, 2017c). Water quality conditions through the watershed are assessed every 5 years based on total phosphorous, Escherichia coli (E. coli) bacteria and benthic invertebrates. Since 2012, there has

been no change in the water quality conditions, which range from fair (grade C) to poor (grade D) in most Upper Thames subwatersheds.



**Figure 3-1. Upper Thames River Watershed**  
(adapted from UTRCA, 2017b)

**3.1.2 Local Study Area Context**

Appendix A-1 and A-2 include many maps of the natural features in the study area including elements from the London Plan. The maps outline natural features, natural hazards, groundwater recharge, significant areas, and regulatory limits. Natural features mapping identifies the Thames River and the

surrounding area as a significant wildlife corridor. Woodlands have been mapped through Harris Park (North Branch), the Thames Park (South Branch) and throughout various sections along the Middle Thames River. Some unevaluated vegetation patches are also shown near the north side of Springbank Dam and near the river's confluence with Mud Creek. The nearest designated Environmentally Significant Areas (ESAs) are the Coves and Sifton Bog.

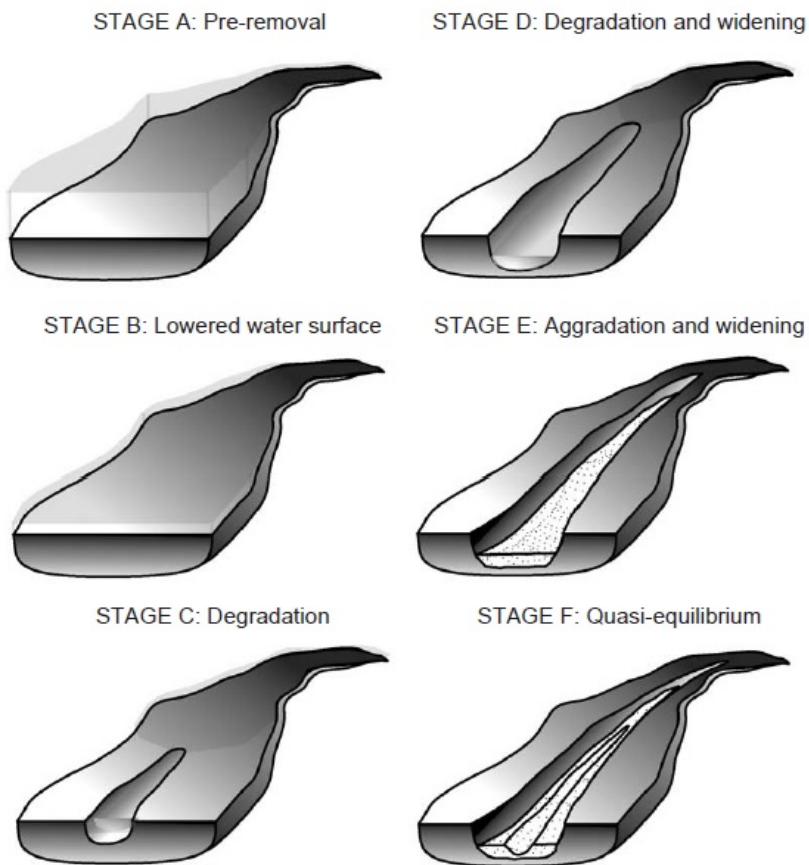
The Thames River through the Study Area has been subject to many typical anthropogenic (from human activity) impacts on river systems. Within the City, the river valley is encroached by urban land use, and confined by several flood protection dykes, and natural and constructed slopes (Parish, 2014). The level of encroachment varies as much of the valley lands remain natural or utilized as parkland, providing some level of a natural or open buffer. Direct and indirect influences from development include efficient delivery of water through the stormwater network, flow modification from major dams or weirs, and direct modification to the corridor through slope stabilization, road crossings, and flood-dyke construction and maintenance.

### 3.1.2.1 General Dam Impacts

Dams have a direct impact on water elevation, streamflow and sediment movement by modifying water flow, depth, and velocity. The Springbank Dam has impacted water levels to create extensive (~7 km) backwater effects to permit recreational boating mainly during the summer months (May to November). When operational, Springbank Dam raised water levels by more than 3 m, expanding the wetted area within the valley, and reducing sediment movement in the downstream direction. In turn, the backwater promoted the deposition of particles of a wide range of sizes within the ponded area, reducing the variability of the channel shape which would naturally occur. The dam affected the channel's ability to maintain the dynamic equilibrium that keeps a natural river healthy. Although the Thames River had free flowing periods in the off-season months, the winter and spring periods were too short to facilitate the natural recovery of the river before the beginning of the next recreational season when the dam was again made operational. Recovery/response following a major change to a river system generally occurs over several years to decades (Knighton, 1998).

When a dam is removed, there is a typical response whereby the base water level lowers and a period of degradation and widening occurs creating a sediment wedge within the impounded side (Figure 3-2). As the channel adjusts to the new free-flowing regime, a bankfull channel establishes within the sediment wedge.

The term "bankfull" represents the condition where water levels in a river are at the top of the banks of the channel. Bankfull flow represents the maximum capacity for a channel to convey flow before inundating the floodplain. The prevailing flow that shapes the bankfull channel is often referred to as the "channel forming" discharge and is thought to have a recurrence interval of 1.5 to 2 years. The conceptual model detailed in Figure 3-2 may not be entirely applicable to the Springbank Dam as it was seasonally operated, and presumably, much of the fine sediment was transported downstream during the spring flows. However, Figure 3-2 does illustrate the trend that has been observed upstream of Springbank Dam, in terms of the development of a bankfull channel with lateral features, and stabilization of the new cross-section with vegetation.



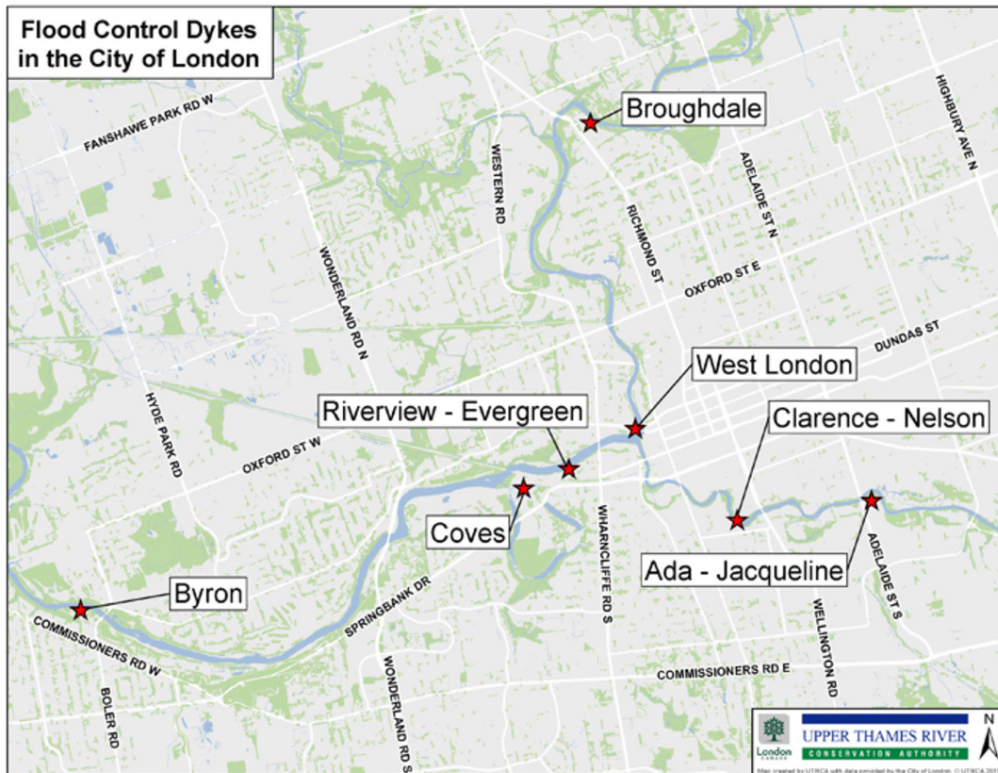
**Figure 3-2. Conceptual Model of Channel Adjustment Following Dam Removal**  
 (adapted from Doyle et al, 2005).

Three major structures impact the Study Area: Fanshawe Dam, Hunt Weir, and Springbank Dam. The *Central Thames Subwatershed Study* suggested that the Fanshawe Dam has had little detrimental impact to sediment supply or erosion in the downstream reaches (Parish, 2014). However, in general, the development of surrounding lands, flow management, and the creation of dams and bank hardening has gradually reduced the actual volume of sediment being supplied to the river. The regulated flows coupled with a reduced sediment supply have the potential to erode the channel boundaries, presenting risk to infrastructure where protection measures have not been implemented. With respect to the Springbank Dam, the *Central Thames Subwatershed Study* noted that the presence of the dam, even in a free-flowing condition acts to disrupt the longitudinal conveyance of sediment with localized accumulation upstream of the Springbank Dam (Parish, 2014).

**3.1.2.2 Flood Control and Dykes**

The flood-prone area of the Thames River is extensive and historical floods have influenced the communities of people who have settled in these areas. The City constructed the first system of dykes after a large flood in 1883 to prevent water entering low-land areas. Dyke construction has continued over time, and presently there are seven dykes with a total length of approximately 5 km (UTRCA, 2017c). The seven dykes are shown on Figure 3-3 and are located along the North Thames, South Thames, and Main Thames Rivers. Within the Study Area, these include the West London Dyke, Riverview-Evergreen, and the Coves. Portions of the West London Dyke have recently been repaired; however, the Coves and Riverview-Evergreen Dykes are still awaiting updates.

In addition to the dykes, three upstream reservoirs, The Fanshawe Dam (North Thames), Wildwood Dam (North Thames) and Pittock Dam (South Thames) are maintained by the UTRCA. These dams were constructed to provide flood protection as well as other objectives including low flow augmentation and recreation. The Fanshawe Dam was constructed in 1952, creating the 2.6 km<sup>2</sup> Fanshawe Reservoir and has reduced the risk from flooding. The Wildwood (built in 1965) and Pittock (built in 1967) dams provide flood control and are also used to augment summer low flow for aquatic habitat and wastewater assimilation.



**Figure 3-3. Flood Control Dykes in the City of London**  
(adapted from AECOM, 2016)

### 3.1.2.3 Wastewater Assimilation

The City operates six wastewater treatment plants (WWTPs) which discharge treated effluent to the Thames River. The wastewater treatment plants discharge approximately 2.30 m<sup>3</sup>/s to the Thames River (City of London, 2017). The largest treatment plant, Greenway, is located 4.5 km upstream of the Dam. The Greenway plant discharges approximately 1.40 m<sup>3</sup>/s and is a significant source of flow into the Thames River through London during low flow periods.

To ensure there is a reliable supply of baseflow during periods of dry weather, the Wildwood and Pittock reservoirs capture flood waters during the spring freshet, and slowly release that stored water through the summer and fall period to augmenting downstream dry weather flow. The primary objective for flow augmentation from Wildwood and Pittock is wastewater assimilation.

### 3.1.2.4 Urban Storm Sewer Infrastructure

The City's network of sewer outfalls is extensive. Outfalls are used to convey stormwater and treated sanitary effluent to the river. Some of the outfalls in the Study Area also function as sanitary sewer overflows (SSOs), discharging stormwater and sewage directly into the river when the system is overwhelmed during an extreme wet weather event. Within the Study Area, 42 outfalls are mapped, including five SSOs.

The majority of the outfalls are located within the upstream reaches of the Study Area, along the North Thames, South Thames, and the Forks areas. Private outfalls also exist along the river including three outfalls upstream of Springbank Dam along the north bank. The City is currently working on upgrading and improving their sanitary and combined sewer infrastructure to prevent overflows in the future (City, 2018b).

### 3.1.2.5 Surface Water Takings

There are a number of operations within the City that have been granted permission by the MECP to withdraw water from the Thames River. These takings are predominantly commercial golf courses that are withdrawing water to irrigate turfgrass. Upstream of the Springbank Dam, a City operated golf course is permitted to withdraw 2,200 m<sup>3</sup>/day. There are six permitted water withdrawals (all for golf course operations) downstream of the dam that are permitted to withdraw a total of 16,200 m<sup>3</sup>/day. When combined, the maximum permitted water takings are 18,400 m<sup>3</sup>/day.

### 3.1.3 River Characterization

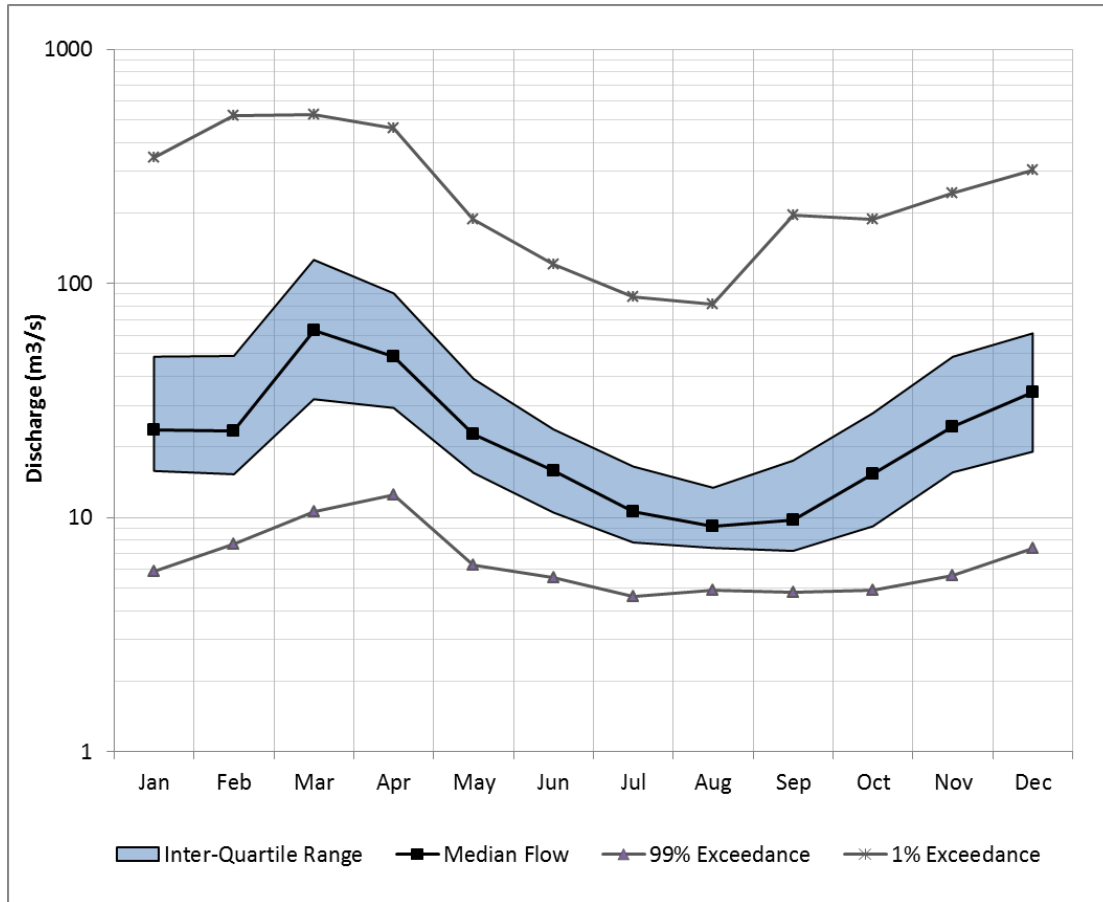
The Thames River consists of a wide, low gradient, fairly homogenous channel with a quasi-regular series of pools, riffles, runs, and several bar formations. Through the City, the River Valley is encroached by urban land use, and confined by several flood protection dykes and natural and constructed slopes (Parish, 2014). The level of encroachment varies as much of the floodplain remains natural or utilized as parkland.

Rivers are dynamic features that develop their geometry in response to streamflow and sediment characteristics, as well as influencing factors such as land use, climate, direct human intervention, geology, and vegetation. Over time, morphological (shape of the river channel) adjustments are common in response to changes in these variables.

#### 3.1.3.1 Hydrology

As a result of the low conductivity soils and agricultural and urban land use in the upstream watershed, the Thames River flow tends to exhibit a flashy hydrologic response, rapidly peaking and declining in response to rainfall and snowmelt events. While there are isolated areas that sustain groundwater discharge, the Thames River is generally seen as an overland runoff-dominated system that does not generate large amounts of baseflow during periods of dry weather.

The Water Survey of Canada (WSC) has maintained a hydrometric (streamflow) monitoring station on the Thames River at Byron (Station ID: 02GE002) downstream of Springbank Dam since 1922. To provide context on the historical flows upstream of the Springbank Dam, Figure 3-4 summarizes and illustrates daily flow data measured from 1970 to 2015. Typical to southern Ontario, the highest monthly flows occur in March and April during the spring. Flows then decline into the summer months, reaching the lowest average monthly flow in August and September, before increasing flows again into the fall. The average annual flow in the Thames River at Byron is 42.8 m<sup>3</sup>/s, however when the river is used most for recreation (between May and October) flows average 22.0 m<sup>3</sup>/s.



**Figure 3-4. Water Survey of Canada Station at Byron – Monthly Flow Summary from 1970-2015**

Additional flow statistics including peak and low flow statistics for the Main Thames, North and South branches are provided in Appendix A-1.

**3.1.3.2 Riparian and Bank Re-Vegetation**

Aerial photograph interpretation and site visits revealed that the Thames River within the former impact zone of the Springbank Dam has responded to free-flowing conditions by developing a narrower channel, with bar formations along the margins that have vegetated over recent years (Figure 3-5). This trend is consistent with the conceptual patterns of an inset bankfull channel development suggested on Figure 3-5 where, over the past decade, lateral and mid-channel bars and benches have vegetated, enhancing their permanency as grasses, shrubs, and small trees establish and grow. The riparian vegetation is a mix of native species and invasive species that add root cohesion and roughness, enhancing the overall stability of the system, and provides a protective buffer to the valley slope.

Vegetated mid-channel bars and lateral floodplain features have become more permanent features diverting or concentrating flows, (providing variability) and accumulating sediment and nutrients, thereby enhancing water quality and the riparian zone through nutrient uptake. Prior to the current free-flowing situation, floodplain features (benches), and island bars were flooded seasonally during dam operation for extended periods. During these periods of flooding, the settlement of fines and nutrients would occur throughout the watercourse rather than sorted at select depositional features or on the floodplain. Riparian areas were submerged during the growing season, and during low flow months, exposed bars/benches lacked vegetation cover and stability through root cohesion.

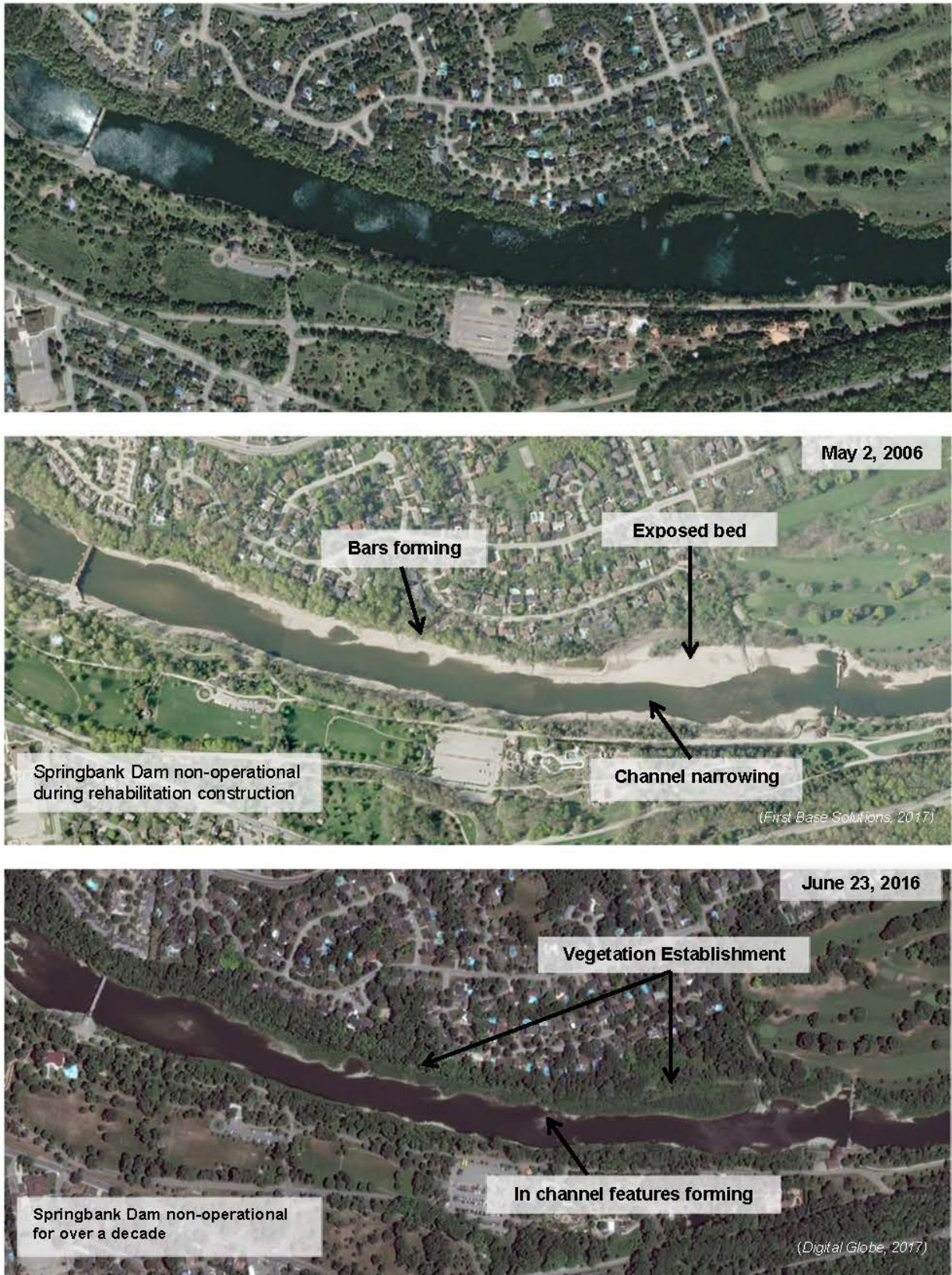


Figure 3-5. Aerial Photographs Series of Reach M4 - Upstream of Springbank Dam (1.2 km)



### 3.1.3.3 River Sediment

As the river channel narrows, flows concentrate, which increases flow velocities and shear stress. These changes increase the capacity for sediment transport and sorting, which enhances the fluvial (river) and aquatic systems. In general, a coarsening of river bed substrates is expected as a result of flow concentration. Detailed river bed substrates were characterized at a number of cross-sections in October 2017. Pebble counts (size of sediment particles) from 2009 and 2012 were available for cross-sections near the Springbank Dam (2009), and downstream of Wonderland Road near the Rowing Club (2012). A sediment grain size characterization comparison for these locations is provided in Table 3-1.

**Table 3-1. Grain Size Distribution**

Location	Grain Size Percentile	2017	2009/2012	% Difference
Rowing Club -(Reach M3) <sup>a</sup> 2012 - XS7	D <sub>10</sub> (cm)	0.80	1.59	-50%
	D <sub>50</sub> (cm)	7.39	12.8	-42%
	D <sub>90</sub> (cm)	49.2	38.4	28%
U/S Springbank Dam -(Reach M4) <sup>b</sup>	D <sub>10</sub> (cm)	0.57	0.15	280%
	D <sub>50</sub> (cm)	7.10	11.7	-39%
	D <sub>90</sub> (cm)	18.3	29.4	-38%

<sup>a</sup> From cross-section 9 in PARISH (2014) Study

<sup>b</sup> From cross-section 9 in PARISH (2010) Study

Based on these comparisons, there is no clear trend in adjustment of the grain size distribution. Some coarsening is evident upstream of the Springbank Dam. However, only 25 particles were measured per cross-section in 2009, as compared to 100 in 2017, therefore reducing the ability to produce a confident interpretation in the perceived adjustment. Unfortunately, substrate characterizations are not available from a period of Springbank Dam operation to confirm the hypothesis that substrates coarsen as the sediment wedge is mobilized and flows concentrate during channel narrowing. However, the lack of fines along the thalweg (center of the river) upstream of the Springbank Dam suggests that there is little deposition in this area. During field observations, fines were primarily located in bar formations along the margins, within alcoves and small areas of recirculation.

In addition to river classification based on planform (e.g., meandering, braided, and straight), rivers can be characterized further based on their dominant material (e.g., sand bed channel, gravel bed channel, and bedrock). Observations of bed substrates are key to understanding erosion processes, the capacity for the channel to transport material, bed armouring, and habitat types. Accurate determination of the particle size distribution of bed material requires sampling and analysis, particularly for coarse bed material, but for most bed material distributions, rough approximations can be derived from visual observation. Generalized sediment mapping was completed through the study area and is provided for each reach in Appendix A-1. The most common sediment types included cobble, boulders, and gravel.

### 3.1.3.4 Recent High Flow Events

The Thames River is a low gradient system; even large flood events do not produce erosive forces substantial enough to severely rework local, coarse sediment. Even finer bar formations near the Forks remain relatively stable, though there is likely a release and collection of sediment as the flood peaks and falls. Although these bar formations exist in low-velocity zones or areas of expansion, major flood events have not created any significant modification to these features, or any rapid planform alterations. Table 3.2 shows the dates and magnitudes of each high flow event (events greater than the 2-year flow of 578 m<sup>3</sup>/s) from 2006 to 2018. Since the non-operation of the Springbank Dam in 2006, there have only been eight events greater than 2-year return period and the majority of these events have occurred in 2008 and 2009.

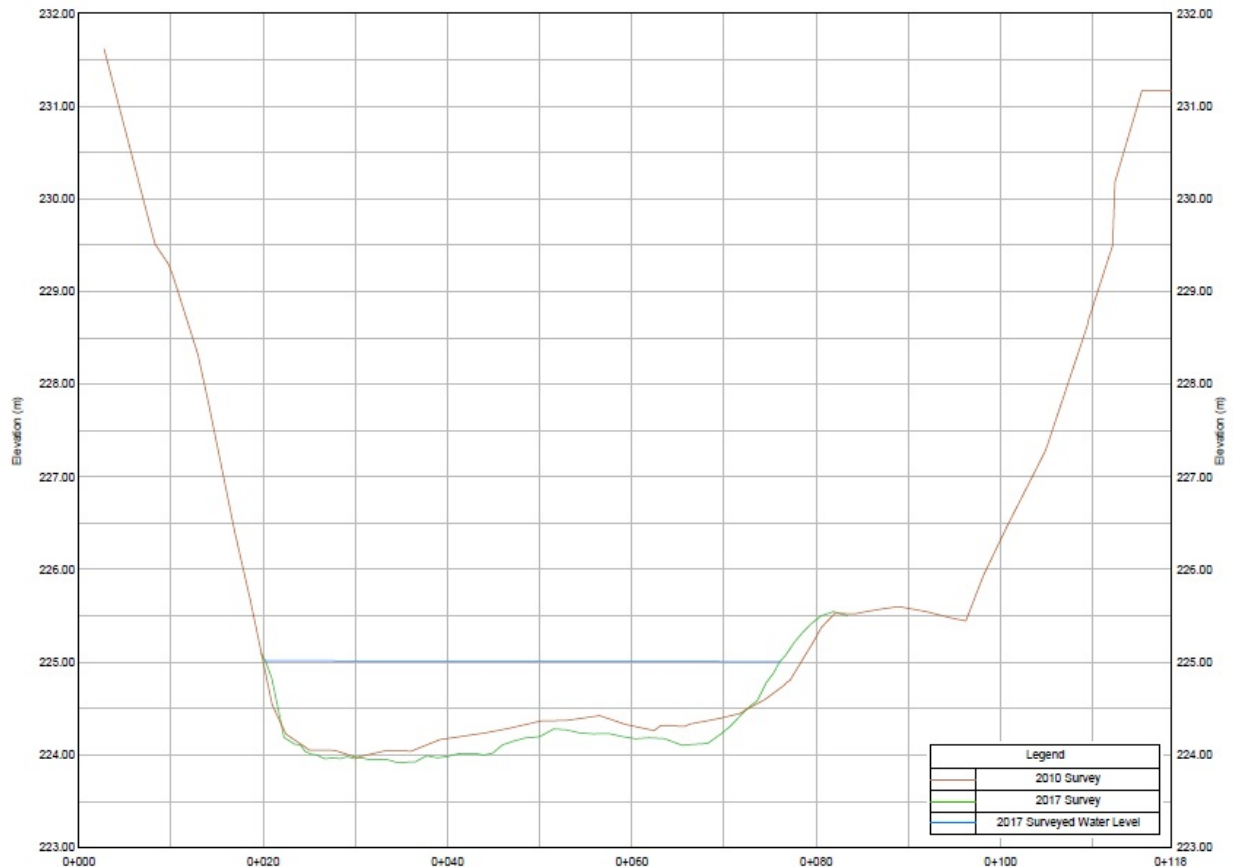
**Table 3-2. High Flow Events on Thames River Since 2006**

Date	Flow (m <sup>3</sup> /s) <sup>1</sup>	Comparable Return Period Flow
January 10, 2008	601	2-year
April 2, 2008	809	5- to 10-year
December 28, 2008	735	5-year
December 29, 2008	856	10-year
February 12, 2009	800	5- to 10-year
February 13, 2009	826	10-year
March 12, 2013	583	2-year
February 22, 2018	1,020	50-year

The lack of high event flows may be the reason minimal changes in sediment size and morphology was noted between the 2009 and 2012 sediment size distributions (Table 3.2) and cross-section comparison (Section 3.1.3.5). Between the 2009/2012 and 2017 sampling periods, only one flow event in March 2013 had flows exceeding the 2-year return period. The February 2018 event occurred after the pebble counts in October 2017 were collected. Future work should aim to characterize the sediment distribution in the context of large flood events, and possibly map changes in topography for bedforms to identify locations where flood events have a morphological response. Such a study would need to span decades in order to capture significant flood events in such a regulated system.

**3.1.3.5 Evolution of the River Channel**

Field surveys and desktop analysis were conducted with the intent to identify ongoing adjustments in the channel cross-section since the period of non-operation of the dam. Surveys completed in October 2017 (Appendix A-1) were compared to available topographic data from the UTRCA hydraulic model and previous surveys associated with studies of the Springbank Dam and Central Thames (Parish, 2010, 2014). Unfortunately, detailed geomorphic surveys before 2006 are not currently available. Figure 3.6 provides an example of cross-section adjustment over the last 5 years. Although this does not compare directly with channel form before the free-flowing system, some trends in lateral bar growth are evident, along with bed degradation. The composition of the bankfull bench, or lateral bar (right side of Figure 3.6), was primarily cobble and gravel, with a layer of fines, well-vegetated by tall and short grasses, willows, and other young deciduous trees. Benches were observed throughout the Study Area, having similar cobble/gravel composition and vegetation types. These benches were evident along one or both banks. These lateral features had a greater proportion of fine gravels and sands in the upper reaches, compared to the cobble/boulder benches downstream of Wonderland Road.



**Figure 3-6. Reach M3 Cross-section Comparison Between 2012 and Recent 2017 Surveys**

### 3.1.4 Natural Hazards and Erosion

Natural hazard mapping in the London Official Plan identifies the steep slopes, erosion hazard limits, and special policy areas in the study area (the City 2008a; maps updated in 2015). In addition to the natural hazards noted at many locations, the banks of the river have been artificially hardened in several locations through the application of bank armoring. This hardening is most prevalent along the South Thames, near the dykes, at the Forks, along the Greenway WWTP, and near the Springbank Dam.

Zones of active erosion in the Study Area have been previously documented in the *Central Thames Subwatershed Study* (Parish, 2014). An updated erosion inventory was completed through the study area, which identified areas for remediation to accompany any channel improvements (Appendix A-1). Where the risk is immediate, or appears immediate, a note has been included.

A survey of erosion hazards in October 2017 revealed that fluvial erosion (bank and bed scour) was most pronounced near the Forks, extending upstream into the North and South Thames Rivers, and downstream toward the Canadian National Railway (CNR) crossing. At the Forks, observations include failure of gabion baskets (Photo 3-1) as well as failure along steep banks downstream of the confluence posing potential risk to the multi-use trail (Photo 3-2). Toe (base of the river bank) erosion was also observed along the south bank near the Greenway WWTP and the Riverview-Evergreen Dyke, and near the CNR crossing. The latter site showed evidence of scour beneath the concrete retaining wall along the toe of the rail embankment (Photo 3-3). Additionally, permanent lowering of the water level due to Springbank Dam non-operation has resulted in the outflow channels from stormwater outfalls becoming elevated and less stable, with several showing signs of failure (Photo 3-4).



**Photo 3-1. Degraded Gabion Baskets at the Forks**



**Photo 3-2. Over-steepened Banks, Toe Erosion Downstream of the Forks (left bank)**



**Photo 3-3. Localized Scour at Toe of Rail Embankment Retaining Wall**



**Photo 3-4. Outflow Channel Slope Failure, South Thames**

### **3.1.5 Water Quality**

A statistical analysis was performed on available water quality data from three stations: Byron, Springbank, and Wharnccliffe. The objective was to determine if the concentrations of specific water quality parameters were significantly different over the years with the dam operational, compared to without the dam. The full water quality report can be found in Appendix A-7.

#### **3.1.5.1 Methods**

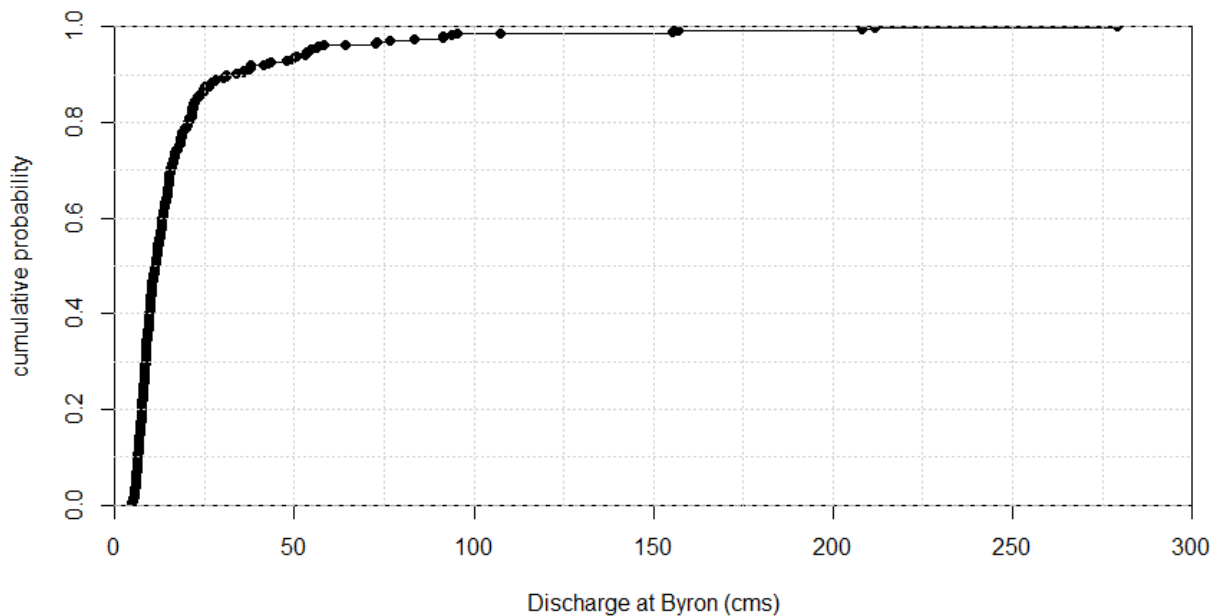
Raw observed data, typically recorded at a weekly frequency, from the summer months (June through September) of 1987-2016 at Byron and Springbank, and from 1978-2016 at Wharnccliffe, was analyzed using the R statistics software platform (R Core Team, 2017).

The parameters total phosphorus and suspended solids were chosen for the analysis because a) sufficient data was available for each parameter across the time periods where the dam was present and then absent; and b) these parameters are primary indicators of water quality that are more likely to be affected by the change in hydraulic characteristics associated with the transition from a dammed to free-flowing river.

The summer data was divided into dry weather and wet weather samples based on analysis of the cumulative distribution of discharge data at Byron. Close inspection of the plot (Figure 3-7) yielded an estimate that 22.0 cubic metres per second at Byron was a threshold above which the river was assumed to be flowing at a wet weather condition, and below which was assumed to be dry weather.

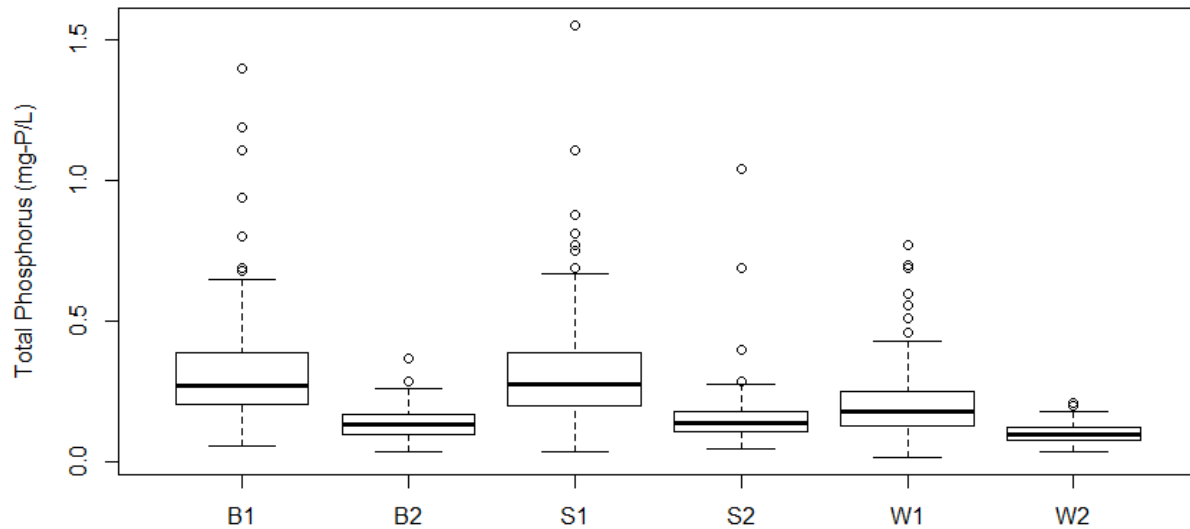
Measurements from common dates at Springbank and Wharncliffe were then categorized as dry weather or wet weather, based on the discharge measured on that date at Byron. Dry weather samples are of particular interest, since the presence of a dam is more likely to influence water quality under dry weather rather than wet weather conditions.

To be conservative, the period with the dam in operation was identified as prior to July 9, 2000 when the dam was damaged. The period without a dam was identified, again, to be conservative, as July 2008 to present to account for the time period after the final failure of the new structure. Data from those intervals were used accordingly for the statistical analysis.



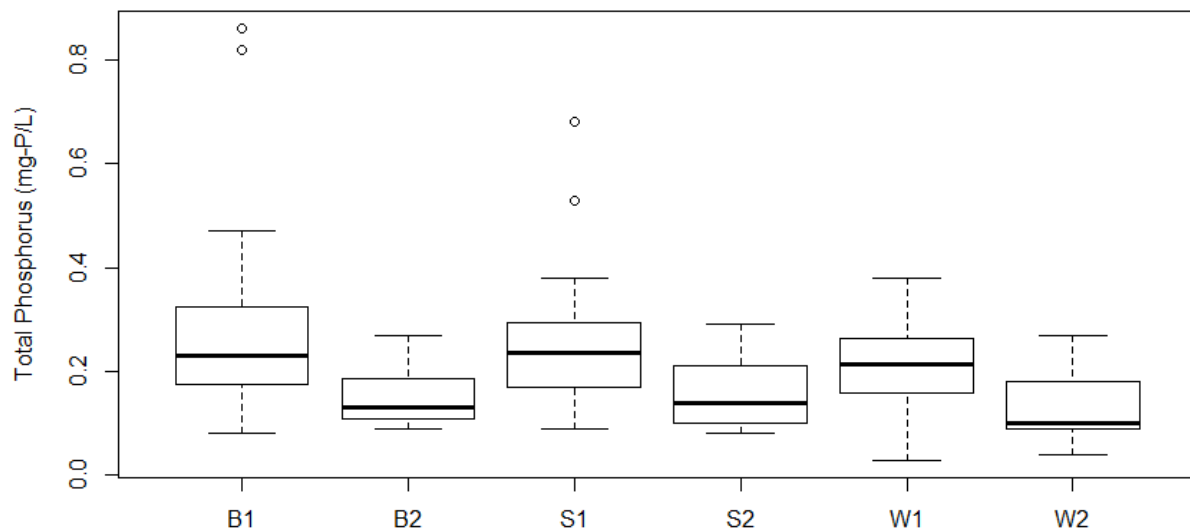
**Figure 3-7. Cumulative Distribution Plot of Discharge at Byron**

Boxplots were generated for each of the datasets (Figures 3-8, 3-9, and 3-10). Due to the non-normal distributions of the datasets, the Wilcoxon rank sum test was applied in each case. This test is the non-parametric analog to the more well-known Student's t-test. The test was performed to determine whether the parameter concentration was greater with the dam than without the dam. P-value results less than or equal to 0.05 indicate statistical significance at the 5% significance level. Average concentration values of each case were also calculated (Table 3.3).



**Figure 3-8. Boxplots of Summer Dry Weather Total Phosphorus Concentrations**

On this and the following boxplots, B= Byron, S= Springbank, W= Wharnccliffe, 1= period with the dam, 2= period without the dam. Box lines are drawn at the 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentiles. Boxplot whiskers extend to the lesser of 1.5 \* the interquartile range or the minimum/maximum datapoint. Outliers are those points outside the interquartile range.



**Figure 3-9. Boxplots of Summer Wet Weather Total Phosphorus Concentrations**

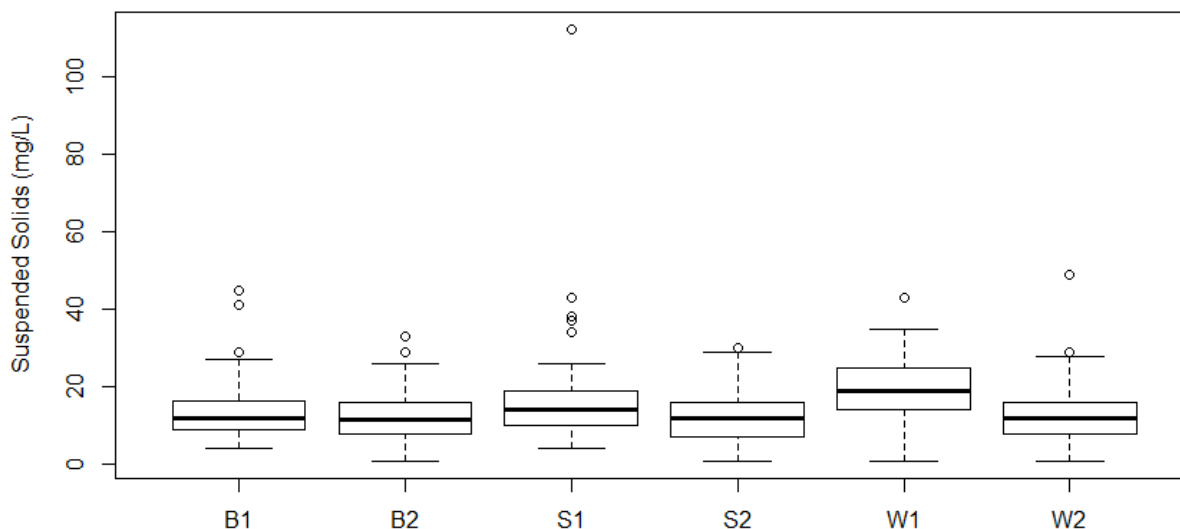


Figure 3-10. Boxplots of Summer Wet Weather Total Phosphorus Concentrations

3.1.5.2 Results

Table 3-3 contains statistical analysis results for comparisons of the given parameter with and without the dam, at summer dry or wet weather conditions.

Table 3-3. Statistical Analysis Results

	Average Concentration with Dam (mg/L)	Average Concentration without Dam (mg/L)	Significantly Greater Concentration with Dam?	p-value
<b>Total P<sub>dry</sub></b>				
Byron	0.3262	0.1436	Yes	< 2.20E-16
Springbank	0.3246	0.1646	Yes	< 2.20E-16
Wharcliffe	0.2084	0.1066	Yes	6.41E-15
<b>Total P<sub>wet</sub></b>				
Byron	0.2807	0.1479	Yes	0.0002175
Springbank	0.2689	0.1572	Yes	0.0008681
Wharcliffe	0.2078	0.1311	Yes	0.004358
<b>Suspended solids<sub>dry</sub></b>				
Byron	13.62	12.19	No	0.117
Springbank	16.51	12.24	Yes	0.0103
Wharcliffe	19.68	13.34	Yes	3.80E-07

The results indicate that total phosphorus concentrations in summer were significantly greater at each station with the dam, compared to without the dam, both at dry and wet weather conditions in summer. In particular, during dry weather, the average total phosphorus concentration was about twice as high with the dam than without the dam at each station. This represents a substantial reduction in phosphorus concentration during the critical summer period when eutrophication is a greater risk.

Average concentrations of dry weather total phosphorus increased downstream and were approximately 50% greater at Byron and Springbank than at Wharncliffe, perhaps due to effluent from the WWTP located between Wharncliffe and Springbank stations. Dry weather average concentrations of total phosphorus at each station were greater at each station than during wet weather, with the dam in operation. However, without the dam, slightly greater average total phosphorus concentrations were observed at Wharncliffe and Byron in wet weather. This shift may be due to a smaller degree of difference in river conditions between dry and wet weather when the dam was not operational.

Suspended solids concentrations were significantly greater at the two upstream stations, Springbank and Wharncliffe, with the dam, compared to without the dam, during dry weather in summer. The absence of a dam might have driven a greater degree of change in river depth and velocity at the upstream two stations, yielding a larger decrease in suspended solids there. For both the dammed and free-flowing conditions, suspended solids decreased downstream, perhaps due to dilution.

### 3.1.6 Terrestrial Ecology

The Thames River and valley corridor is known as a unique area for biological diversity that attracts various terrestrial wildlife species. The combination of water, riparian areas, and woodlands promote an opportunity for species to occupy and migrate between a multitude of habitats. The forested valley slopes and wide river corridor separate the natural environment from the surrounding urban landscape. The width and longitudinal connectivity of the terrestrial corridor has increased since the lowering of water levels, allowing for vegetation to establish and more stable slopes to form. A full description of the terrestrial environment is presented in Appendix A-2.

#### 3.1.6.1 Vegetation

Vegetation characterization through the area has historically been documented through land use mapping, aerial imagery, ecological land classification (ELC) and flora inventories. The most extensive (spatial) study of vegetation is an ELC completed as part of the ENVision Thames River Valley Corridor Plan (Dillon et al. 2011). The study examined 47 vegetation patches greater than 0.5 ha along the Thames corridor. Between Springbank Dam and the Forks, eight vegetation communities were mapped, including deciduous forest (most dominant), cultural woodland (second most dominant), cultural meadow, mixed forest, coniferous forest, meadow marsh, and open aquatic.

A localized shoreline vegetation study was initiated by the UTRCA within the study area. The review was conducted in 2007, 2010, and 2014 and reported in 2015 (UTRCA, 2015a), showing the chronology of vegetation establishment within several vegetation plots within the riparian corridor. The findings from the shoreline vegetation study are of interest as they were a direct observation of the vegetation changes along the river since the non-operation of the Springbank Dam. Vegetation plots were examined for diversity, Floristic Quality Index (an index of vegetation quality based on plant species composition and abundance), and other scoring parameters. Inventories found the number of native and non-native species within the plots to be relatively similar. The Floristic Quality Index increased throughout the plots over time due to the larger number of species found and was considered in the moderate range for diversity. The recommendations in the UTRCA report suggest allowing the vegetation to continue to naturalize and monitor these changes. Over time, the vegetation has since covered over 10 ha of land.

#### Flora

Previous flora inventories listed three SAR that have been observed in the area including Butternut (*Juglans cinerea*), Kentucky Coffee Tree (*Gymnocladus dioicus*), and Red Mulberry (*Morus rubra*; may be a hybrid). Green Dragon (*Arisaema dracontium*) was the only species confirmed for the area in the 2016 MNRF species at risk letter and is considered a Special Concern species (Appendix A-2). The remaining SAR flora were all inferred in previous studies based on the presence of other vegetation communities. Several of the floral SAR prefer wet, riverine/floodplain environments including the Butternut and Kentucky Coffee Tree, which could now potentially inhabit the largest riparian environment. However, no plant SAR were found by UTRCA during the three-year vegetation succession study.



A total of 57 rare species with a S3 ranking or higher (S2, S2, SH, or SX) were listed as potentially occurring within the study area from previous studies. The majority (53 percent) of these plants were never found, and only listed as potential, particularly in the West London Dykes Subject Lands Status Report (SLSR) (UTRCA, 2015d). Of the 57 species identified only four species were observed within the study area and included Hairy-fruited Sedge (*Carex trichocarpa*), Hispid Buttercup (*Ranunculus hispidus*), Trumpet Creeper (*Campsis radicans*), and Honey Locust (*Gleditsia triacanthos*).

### 3.1.6.2 Terrestrial Wildlife Inventories

Terrestrial wildlife includes birds, mammals, herpetofauna and insects and is separated from aquatic wildlife. Although terrestrial species may interact with the riverine environment or surrounding vegetation within the Thames corridor, these species spend much of their life cycle outside of the aquatic environment. Inventory record reviews were completed through online database searches and atlases and supplemented with observations from previous reports. A detailed inventory is outlined in Appendix A-2 and includes 197 birds, 41 mammals, and 34 species of herpetofauna that have been observed or have the potential to occupy the study area.

Birds observed in the area from previous studies cover several different families including swallows, thrushes and woodpeckers. Geese, ducks, herons and kingfishes along with other aquatic birds and water fowl have also been observed utilizing the area upstream of the dam. Generally, birds will utilize the Thames River and adjacent corridor for foraging, nesting, and shelter, with overwintering occurring in areas of faster moving water that is not prone to freeze up.

As the Thames River is surrounded by parkland and interspersed by natural lands, mammals generally utilized the Thames River as interconnected habitat allowing opportunities to exploit the urban setting. Common wildlife tolerant of human disturbances are able to thrive within the Thames corridor and maintain a healthy population within the city. Sightings of several mammals have been observed within the study area including rodents, beavers and larger mammals such as coyotes and white-tailed deer.

Herpetofauna, collectively known as amphibians and reptiles, include snakes, turtles, lizards, frogs, toads, salamanders, and newts in Ontario (Ontario Nature, 2017). Many of these species utilize river habitats for a wide range of functional habitat needs including foraging, breeding and nesting. The most common herpetofauna documented recently within the study area include the Eastern Spiny Softshell turtle, Eastern Gartersnake and Northern Map turtle.

#### Birds

Of the 23 potentially occurring bird species at risk in the area, eight have been observed including: Bank Swallow (*Riparia riparia*), Barn Swallow (*Hirundo rustica*), Chimney Swift (*Chaetura pelagica*), Common Nighthawk (*Chordeiles minor*), Eastern Meadowlark (*Sturnella magna*), Olive-sided Flycatcher (*Contopus cooperi*), and Wood Thrush (*Hylocichla mustelina*). Many of these species were found along the South Thames and the Coves, where more meadow environment exists adjacent to the Thames River Valley. Some species such as the Olive-sided Flycatcher will use forests adjacent to rivers and wetlands for breeding where other such as the Chimney Swift and Barn Swallow will use the river for foraging. Furthermore, a total of 19 Species of Conservation Concern (SCC) were confirmed within the study area.

#### Mammals

There are 42 mammal species that have the potential or have been observed in the study area based on the OMA and previous studies. An inventory of mammal species from background contains typical urban mammal species. Potential occurrences from each study were based on previously recorded observations.

Only 14 of the 42 mammals were observed within the study area. The most common sightings were Grey Squirrel (*Sciurus carolinensis*), White-tailed Deer (*Odocoileus virginianus*), Eastern Chipmunk (*Tamias striatus*), and Raccoon (*Procyon lotor*).

Five SAR mammals were listed as having potential to occur in the area. The Small Footed Bat (*Myotis leibii*) was the only SAR mammal observed during the previous studies North Branch. No SCC were observed within the study area.

**Insects**

One SAR insect (Rusty patched Bumble Bee (*Bombus affinis*)) was listed as potentially occurring within the area but was never observed. Six SCC butterflies were identified as potentially occurring within the area. One of these species (Monarch (*Danaus plexippus*)) was sighted during several of the previous studies. Monarchs feed on milkweed which prefers wet soils such as riverbanks and other riparian areas.

**Herpetofauna**

The majority (75%) of Ontario’s reptile species are listed as SAR. The major cause of listing is due to habitat loss and fragmentation, as these species tend to occupy more sensitive habitats (e.g., wetlands and shorelines).

A total of 34 species were identified as potentially occurring within the study area. Eight of the herpetofauna that have potential or have been observed within the study area are classified as SAR. The Eastern Spiny Softshell (*Apalone spinifera*) was the only confirmed SAR within the study area. The Spiny Softshell turtle, unlike other turtle species, uses the riverine environment for all critical life-cycle requirements including breeding and foraging. It is the most documented and well-known SAR to inhabit this area of the Thames River.

Two SCC observed within the study area include the Northern Map turtle (*Graptemys geographica*) and Common Snapping Turtle (*Chelydra serpentina serpentina*). These two species also utilize the river for critical habitat needs (e.g. hibernating).

**3.1.7 Aquatic Ecology**

Aquatic habitat within the study area has historically been impacted by the operation of the Springbank dam which resulted in backwater upstream of the dam for several kilometers, creating a lentic (still water) ecosystem. This low energy environment limited sediment movement which, in turn, has resulted to minimal variation in bed forms and a more uniform habitat for aquatic life. Since 2006 the riparian corridor has been expanding and creating a larger functional habitat along the channel margins. Vegetation establishment along the banks have developed into dense shrub growths, creating a littoral zone in areas that were formerly submerged and bordered by retaining walls and dykes.

Previous reports on the aquatic habitat within the area have been limited and generally subject to studies surrounding structural components such as a dyke or bridge. The Byron Dyke SLSR completed in 2017 (UTRCA, 2017), concluded that the habitat within the subject lands (downstream of the dam) was in good condition with optimal scores for channel flow, riffle frequency and epifaunal cover. Suboptimal scores were given for bank stability. Similarly, the West London Dykes SLSR aquatic habitat assessment completed in 2015 (UTRCA, 2015d), concluded that the subject lands at the Forks was also in good condition with high scores for epifaunal cover and low amounts of sedimentation. Suboptimal scores were given for riffle frequency, banks stability, and riparian zone width.

The study team completed detailed aquatic habitat mapping at four locations within the study area; the Forks, Greenway Park, the Old Pumphouse, and Springbank Dam. The aquatic habitat mapping aligns with the 2017/2018 fisheries locations and aided in identifying microhabitats as well as food sources and reliable migration routes.

**3.1.7.1 Aquatic Wildlife Inventories**

UTRCA identified over 150 aquatic fish, mussel and amphibian/reptile species that inhabit the Thames River and adjacent tributaries (UTRCA, 2017d). Inventories of fish, mussels, herpetofauna and benthic

macroinvertebrates are documented by agencies such as DFO, MNRF, and UTRCA since 1967. To supplement the agency studies with recent data, additional fisheries surveys in 2017 and 2018.

## Fisheries

Background fisheries data has been compiled by fish sampling records from DFO, Royal Ontario Museum, MNRF, and UTRCA between 1967 and 2018. In the study area, a total of 68 different fish species have been documented from the UTRCA records between 1967 and 2018 (Appendix A-2). The most common species found over the sampling period were Greenside Darter (*Etheostoma blennioides*), Rock Bass (*Ambloplites rupestris*), Smallmouth Bass (*Micropterus dolomieu*), and Striped Shiner (*Luxilus chrysocephalus*).

The 2017 fisheries surveys in Appendix A-7 and the 2018 fisheries surveys in Appendix A-4 and A-5 focused on four select areas: the old pump house upstream of Springbank Dam, Greenway Park upstream of Wonderland Road, the Fork and the South Thames Branch, just south of the Forks. During both visits, the most common species caught were members of the minnow family making up over 80% of the total species sampled. The most common individual species sampled were Common Shiner (*Luxilus cornutus*), Rosyface Shiner (*Notropis rubellus*), Emerald Shiner (*Notropis atherinoides*) and Silver Shiner (*Notropis photogenis*). The free-flowing river system has allowed for the development of vast areas of riffle, flats and coarse substrates that support large schools of these minnow species.

Since the spatial and temporal extents as well as the methods of collection for each of the fisheries programs varied, it is difficult to draw conclusions about population changes and trends. There is no direct connection between the presence of fish species within the area before and after operation of Springbank Dam in 2006. However, the number of Silver Shiner observed have increased with current studies (2011-present) where previously Silver Shiner were only documented downstream during the 2003 Riverbend survey.

The *Distribution of Fish Species at Risk* (DFO 2017) maps are provided in Appendix A-7. The map indicates that the Special Concern species and species under consideration for listing (Endangered or Threatened) have critical habitats throughout the study area. The DFO mapping did not indicate critical habitat within the study area for fish species.

## Springbank Dam Fish Passage Study

A study completed by Biotactic in October 2010 (Biotactic, 2010), monitored 3 years of fish movement at the Springbank Dam during open flow conditions. Fish passage data from three species with varying swimming abilities and migration timing windows, White Sucker (weak), Shorthead Redhorse (moderate), and Smallmouth Bass (strong), were monitored each year for various components of fish passage (e.g., attraction, efficiency). The data was compared to the pre-construction data from 2006 during a period where the Springbank Dam was not in operation and the stop logs were not in place. The findings of the study summarized that although the dam does provide some interference to fish passage, it is not seen as a complete barrier.

## Mussels

The Thames River hosts the second most diverse freshwater mussel population in Canada (UTRCA, 2017d). Freshwater mussels typically thrive in free-flowing riverine environments where oxygen is plentiful, siltation is minimal and there is the presence of species specific host fish that each mussel requires to develop from larvae.

Historical mussel surveys were conducted by UTRCA, DFO and Environment Canada in 1998 and 2015 near the Springbank Dam and the North and South Thames tributary sections. Over 20 species including live and shell relics were identified within the study area. Eight SAR mussels have been documented to occur or have the potential to occur within the study area. Mudpuppy (*Simpsonia ambigua*) and Wavy rayed Lampmussel (*Lampsilis fasciola*) were found within the Main branch. Rainbow (*Villosa iris*), Rayed Bean (*Villosa fabalis*), and Round Pigtoe (*Pleurobema sintoxia*) were found in sections upstream of the

Forks in the South and North Thames River branches. Hickorynut (*Obovaria olivaria*) and Kidneyshell (*Ptychobranchus fasciolaris*; also SAR) were listed as potentially occurring, but were never found in the previous studies.

The DFO map of the Distributions of Mussel Species at Risk in Appendix A-7, shows that critical habitat has been outlined for Mapleleaf (*Quadrula quadrula*) and Round Pigtoe within the study area.

Since 2004, no mussel surveys have been completed upstream of the Springbank Dam or in the main Thames branch. The lack of current sampling efforts within the river have limited the understanding of current assemblages, however it is anticipated that these species would likely still be present in the area or have migrated downstream from the North and South Thames branches, now that a free-flowing riverine environment has been established.

**Benthic Macroinvertebrates**

Benthic macroinvertebrates (benthics) are organisms that live on the bottom of a water body (or in the sediment) and have no backbone. Benthics are typically sampled at riffles/run habitats in the spring or fall season, and their taxonomy is classified by family and/or genus levels. The number of benthics in each family/genus level is then related to various biotic indices. These indices are used to determine the health of the river based on the sensitivity and tolerance to pollution at a given location within the river.

Both water quality and benthic monitoring on the Thames River has been ongoing since by the City since 2006. The City’s BioMap monitoring program uses several indices to determine the spatial and temporal trends in water quality of the Thames River. The program has not found any significant improvement trends in the biotic indices upstream of the Springbank Dam (Matrix, 2016). The best benthic and water quality sites continue to be found in the North and South Thames River. These sites had scores that indicate fair to good water quality conditions. The poorest quality conditions continue to be found in the main Thames River, with biotic index scores indicating fair to fairly poor water quality. The decrease in water quality downstream of the North and South branch confluence is attributed to the number of combined sewer overflows and Greenway Pollution Control Plant effluent nutrient loading contributions.

**3.1.8 Significant Species**

Both federal and provincial species classifications and rankings were used to characterize significant flora and fauna found in the study area. Each classification system at the federal and provincial levels defines the level of species and habitat protection.

**3.1.8.1 Species of Conservation Concern**

A total of 93 SCC were identified as occurring or potentially occurring within the study area. The potential SCC were assessed to identify if their preferred habitats were present within the study area (Appendix A-7).

The results of the assessment indicated that of the 93 species identified for the study Area, 17 species were listed as potentially occurring, and 27 species were confirmed. A summary of the potential and confirmed species are provided in Table 3.4. A detailed description of SCC is provided in Appendix A-2.

**Table 3-4. Potential and Confirmed SCC within the Study Area**

Natural feature	Potential	Confirmed
Flora	<ul style="list-style-type: none"> <li>Black-eyed Susan</li> <li>Brainerd's Hawthorn</li> <li>Hairy-fruited Sedge</li> <li>Tall Coreopsis</li> <li>White-haired Panic Grass</li> <li>Wild Four-o'clock</li> </ul>	<ul style="list-style-type: none"> <li>Hispid Buttercup</li> <li>Honey Locust</li> </ul>
Birds	<ul style="list-style-type: none"> <li>Black-billed Cuckoo</li> </ul>	<ul style="list-style-type: none"> <li>Bald eagle</li> <li>Baltimore Oriole</li> <li>Belted Kingfisher</li> <li>Brown Thrasher</li> <li>Eastern Kingbird</li> <li>Eastern Towhee</li> <li>Eastern Wood-pewee</li> <li>Field Sparrow</li> <li>Great Blue Heron</li> <li>Green Heron</li> <li>Killdeer</li> <li>Mallard</li> <li>Northern Flicker</li> <li>Northern Rough-winged Swallow</li> <li>Rose-breasted Grosbeak</li> <li>Savannah Sparrow</li> <li>Sora</li> <li>Spotted Sandpiper</li> <li>Wood Duck</li> </ul>
Herpetofauna	<ul style="list-style-type: none"> <li>Eastern Ribbon Snake</li> </ul>	<ul style="list-style-type: none"> <li>Common Snapping Turtle</li> <li>Northern Map Turtle</li> </ul>
Fish	<ul style="list-style-type: none"> <li>Northern Brook Lamprey</li> <li>Spotted Sucker</li> </ul>	<ul style="list-style-type: none"> <li>Striped Sucker</li> </ul>
Mussels	<ul style="list-style-type: none"> <li>Black Sandshell</li> <li>Deertoe</li> <li>Pink Heelsplitter</li> <li>Purple Wartback</li> <li>Wabash Pigtoe</li> </ul>	<ul style="list-style-type: none"> <li>Elktoe</li> <li>Mucket</li> </ul>
Insects	<ul style="list-style-type: none"> <li>Hackberry Emperor</li> <li>Tawny Emperor</li> </ul>	<ul style="list-style-type: none"> <li>Monarch</li> </ul>

### 3.1.8.2 Species at Risk

The Thames River is known as the only true Carolinian River in Canada and is one of the main reasons that many SAR and Special Concern species are potentially occurring upstream of the Springbank Dam and, generally, within the Thames River. Accordingly, this unique setting hosts species whose northern ranges are limited or non-existent in other parts of Ontario and Canada.

A review of existing information and previous studies indicated that 59 SAR listed as Endangered or Threatened have potential to occur in the study area. While some species only have the potential to occupy the area based on habitat preferences and historical information, many SAR have been observed to utilize the study area for migration as well as residence.

Species observations and habitat potential were used to assess which species are present, or have the potential to be present, within the study area. The results of the assessment provided in Appendix A-2, indicate of the 59 species identified, 10 species have confirmed observations within the study area, 13 species have the potential to occur within the study area, and 36 were considered to be unlikely to occur within the study area based on the existing habitat. The results of the assessment are provided in Table 3.5. A detailed description of SAR is presented in Appendix A-2.

**Table 3-5. Potential and Confirmed Species at Risk within the Study Area**

Common Name	SRANK	SARA (Federal)	ESA (Provincial)	Likelihood of Occurrence
<b>Flora (14)</b>				
American Chestnut	S1/S2	END	END	Unlikely
Bird's-foot Violet	S1	END	END	Unlikely
Blue Ash	S2?	SC	THR	Unlikely
Butternut	S2?	END	END	Confirmed
Cucumber Tree	S2	END	END	Potential
Drooping Trillium	S1	END	END	Unlikely
Eastern Flowering Dogwood	S2?	END	END	Unlikely
False Hop Sedge	S1	END	END	Unlikely
False Rue-anemone	S2	THR	THR	Unlikely
Kentucky Coffee Tree	S2	THR	THR	Confirmed
Purple Twayblade	S2/S3	THR	THR	Unlikely
Red Mulberry	S2	END	END	Potential
Spoon-leaved Moss	S1	END	END	Unlikely
Wood-poppy	S1	END	END	Unlikely
<b>Birds (21)</b>				
Acadian Flycatcher	S2/S3	END	END	Unlikely
Bank Swallow	S4	THR	THR	Confirmed
Barn Owl	S1	END	THR	Unlikely
Barn Swallow	S4B	THR	THR	Confirmed
Bobolink	S4B	THR	THR	Unlikely
Canada Warbler	S4	THR	SC	Unlikely
Cerulean Warbler	S3B	END	THR	Unlikely
Chimney Swift	S4B, S4N	THR	THR	Confirmed
Common Nighthawk	S4B	THR	SC	Potential
Eastern Meadowlark	S4B	THR	THR	Potential
Golden-winged Warbler	S4	THR	SC	Unlikely
Henslow's Sparrow	SHB	END	END	Unlikely
Kirtland's Warbler	S1	END	END	Unlikely
Least Bittern	S4B	THR	THR	Unlikely
Loggerhead Shrike	S2	NAR	END	Unlikely
Northern Bobwhite	S1	END	END	Unlikely
Olive-sided Flycatcher	S4B	THR	SC	Potential
Prothonotary Warbler	S1	END	END	Unlikely
Red-headed Woodpecker	S4B	THR	SC	Unlikely
Wood Thrush	S4B	THR	SC	Confirmed
Yellow-breasted Chat	S2B	END	END	Unlikely
<b>Turtles (3)</b>				
Blanding's Turtle	S3	THR	THR	Unlikely
Eastern Spiny Softshell	S2	THR	END	Confirmed
Spotted Turtle	S2	END	END	Unlikely
<b>Snakes and Salamanders (5)</b>				
Butler's Garter Snake	S2	END	END	Unlikely
Eastern Hog-nosed Snake	S3	THR	THR	Unlikely

Common Name	SRANK	SARA (Federal)	ESA (Provincial)	Likelihood of Occurrence
Eastern Massasauga	S1	END	END	Unlikely
Jefferson Salamander	S2	END	END	Unlikely
Queensnake	S2	END	END	Potential
<b>Mammals (4)</b>				
American Badger	S2	END	END	Unlikely
Eastern Small-footed Bat	S2/S3	Not Listed	END	Potential
Little Brown Bat	S4	END	END	Unlikely
Northern Bat (N. Long-eared bat)	S3	END	END	Unlikely
<b>Insects (1)</b>				
Rusty-patched Bumble Bee	S1	END	END	Unlikely
<b>Fish (3)</b>				
Silver shiner	S2S3	SC	THR	Confirmed
Black Redhorse	S2	NAR	THR	Confirmed
Pugnose Minnow	S2	SC	THR	Unlikely
<b>Mussels (8)</b>				
Wavy-rayed Lampmussel	S1	SC	THR	Confirmed
Salamander Mussel	S1	END	END	Potential
Hickorynut	S1?	No Status	END	Unlikely
Rainbow mussel	S2S3	END	SC	Potential
Rayed bean	S1	END	END	Potential
Round pigtoe	S1	END	END	Potential
Kidneyshell	S1	END	END	Potential
Mapleleaf mussel	S2	THR	SC	Potential

## Notes:

END = Endangered  
 NAR = Not at Risk  
 SC = Special Concern  
 THR = Threatened

### 3.1.9 Natural Environment Summary

The natural environment of the Thames River can be best described as a truly unique system known not only for its ability to sustain a great variety of aquatic species, but also for its biological diversity that attracts various terrestrial wildlife species. The steep forested valleys and wide, shallow watercourse provides areas for many species to occupy, migrate and interact within the system. Since the non-operation of the dam, the river and riparian corridor has continued to diversify following the new flow and sediment regimes, trending toward a new dynamic equilibrium.

As the channel continues to change after the non-operation of the dam, a more meandering shape can be expected to develop. In general, the channel response to the free-flowing system will be limited due to the existing boundaries from natural confinement, and confinement imposed by urbanization and infrastructure such as dykes. With recreational lands (i.e., parks) and infrastructure (i.e., dykes, bridges, and treatments) extending along the entire study Area, there is little opportunity for lateral migration of the river into the floodplain. Channel narrowing will continue; however, lateral confinement coupled with a lack of available floodplain can still promote channel incision and associated instability. Although there have been some clear channel trends and changes of the Thames River in the study Area, which is most evident in the aerial photograph analysis, evolution of the Thames River channel will continue to adjust and change slowly over time. The recovery/response to a river system can take decades (Marston and Knighton, 1986) and will largely depend on the frequency and magnitude of flows that occur.

The Thames River flows through urban and rural agricultural lands and is largely a warm water, flow-controlled system, however, its southerly location within the Carolinian zone provides habitat for SAR whose ranges are restricted and endemic to Southwestern Ontario. A review of existing information and background studies found 10 species at risk listed as endangered or threatened under SARA and/or the ESA within the study area. Many of these species at risk have benefited from the free-flowing system that has occurred over the past 10 years and will continue to inhabit and migrate freely through the corridor. Future management of the river environment will need to consider the rivers function as habitat of both species at risk and other indigenous wildlife, as well as its unique attributes in terms of cultural and recreational importance.

## 3.2 Social/Cultural Environment

The social/cultural environment is the environment that has been developed by humans over the past decades and centuries. It includes how humans use and interact with the land now, in the past, and in the future. Important aspects of the social/cultural environment are existing land uses, cultural and archaeological heritage resources, recreational uses, First Nations history, use and knowledge of the Thames River corridor, and planned future land use and infrastructure.

### 3.2.1 Existing Land Uses

The City of London is currently one of Ontario's largest urban centers with a variety of important cultural and environmental resources shaping the City's history and identity. The Thames Valley Corridor is widely recognized as one of the City's most important natural, cultural, recreational and aesthetic resources and, as a result, the Thames River was recognized as a Canadian Heritage River in 2000 (City of London, 2011). The Thames River presence has shaped the City's development and subsequently influenced the existing land use in, and adjacent to, the Thames Valley Corridor.

Within the Thames Valley Corridor itself, land use consists of nature-oriented parkland, valleyland open space, and a system of pathways and trails (City of London, 2011). These uses provide excellent opportunities to support healthy lifestyles and promote wellness, offer affordable and unstructured recreational pursuits, increase tourism, and facilitate cultural and natural heritage appreciation. The existing developed park area provides recreational facilities including playing fields and picnic areas which serve as community and neighbourhood social areas. Specifically, the valleyland along the Thames River and its tributaries provide primary open space resources including a continuous, linear open space network of trails and pathways connecting individuals and communities, with a distributed open space system consisting of natural areas, parks, activity areas and facilities.

Currently, there are few locations along the Thames Valley Corridor for potential interaction with the Thames River. These locations include: Springbank Pumphouse area, Riverside boat launch, rowing club, canoeing club, and fishing docks as well as several locations where informal river access has been created.

### 3.2.2 Archaeological and Built Heritage

The scope of the One River EA cultural heritage overview involved identifying cultural heritage resources within the study Area, reviewing previous research and reporting, and recommending measures to ensure cultural heritage resources are considered in the preferred options. All analysis and recommendations followed guidance outlined in the Ministry of Tourism, Culture and Sport's (MTC) *Ontario Heritage Tool Kit* series, municipal documents such as the City's *Official Plan*, *Cultural Prosperity Plan*, and *2015-2019 Strategic Plan*, as well as recognized conservation manuals such as *Canada's Historic Places Standards and Guidelines for the Conservation of Historic Places in Canada*.



The cultural heritage overview resulted in the identification of the following cultural heritage resources within the study area:

- Two properties designated as a National Historic Site of Canada under the *Historic Sites and Monuments Act* (R.S.C., 1985, c. H-4), with plaques also erected on the property;
- Fourteen (14) properties designated under Part IV of the *Ontario Heritage Act*;
- Nine of these are included on the Canadian Register of Historic Places.
- Two of these have an Ontario Heritage Trust easement.
- Fifty properties designated under Part V of the *Ontario Heritage Act*, as part of either the Blackfriars-Petersville Heritage Conservation District, the Downtown Heritage Conservation District, or the Wortley Village-Old South Heritage Conservation District;
- Forty-four properties inventoried on the Inventory of Heritage Resources 2006 and/or the City's Heritage Parcels GIS layer;
- Three properties identified by the City Heritage Planner as 'properties of interest';
- Three plaques listed on the Ontario Heritage Foundation Online Plaque Guide; and
- One cemetery listed on the MGCS's Database of Registered Cemeteries.

Desktop research also determined that the entire study area is within the floodplain of the Thames River, which is designated under the Canadian Heritage River System (CHRS). Each identified resource and associated recommendation for further action is summarized in Appendix A-3.

Stage 2 Archaeological studies were conducted for the Springbank Dam and Forks of the Thames study areas in November 2018. The detailed reports from these investigations can also be found in Appendix A-3. A commemorative plaque identifying the Sulphur Spring Bathing House was found at the Forks of the Thames. A pre-contact indigenous site, identified by the presence of 13 chert flakes, was found on the south-eastern boundary of the study area (Figure 3-11).

### 3.2.3 Recreational Uses and Activities

Existing recreational areas within the Thames Valley Corridor have been developed to offer a variety of active and passive recreational uses. There are many recreationalists and interest groups using and supporting the enhancement of the Thames River, including anglers' associations and the London Canoe Club. Passive recreational opportunities include activities such as bird watching, walking, canoeing, and the enjoyment of natural features. Active recreational opportunities within the Thames Valley Corridor include activities such as organized sports, playground activities, use of motorized equipment, and fishing. Walking and cycling on the Thames Valley Parkway is also a known favoured activity for users of all ages (City of London, 2009).

Activity areas include existing developed park spaces offering recreational amenities that may also serve as neighbourhood or community social gathering areas. These activity areas for recreational use within the study area include Ivey Park, Springbank Park, Labatt Park, Thames Park, and Greenway Park. These recreational amenities include the following:

- |                   |                         |
|-------------------|-------------------------|
| • Sports fields   | • Splash pads           |
| • Tennis courts   | • Fishing docks         |
| • Swimming pools  | • Rowing club house     |
| • Washrooms       | • Cultural sites        |
| • Water fountains | • Children's play areas |
| • Picnic areas    | • Playgrounds           |
| • Dog parks       |                         |

The City's oldest golf course (Thames Valley) also lies within the study area and directly fronts the river. These activity areas and subsequent recreational uses are anticipated to evolve over time which will provide an opportunity for additional recreational activities to support strong neighbourhoods, healthy lifestyles and a sustainable environment (City of London, 2009).

Historically, the reservoir upstream of Springbank Dam was used for pleasure boating and a ferry service. More recently the London Rowing Club and the London Canoe Club have offered training and programs on the reservoir, although they have since moved to other local water bodies with the non-operation of the dam.

**3.2.4 First Nation and Metis Communities**

First Nations community engagement is essential to the One River EA process. The perspectives and stories of First Nations with respect to their history, knowledge and identity through Aboriginal Traditional Knowledge, as it relates to the Thames River, are important contributions to the One River EA. First Nations peoples have a unique perspective and relationship with the lands and waters within the watershed that include assertions of Aboriginal title, Treaty rights and Aboriginal rights. First Nations have expressed concern about actions they perceive may influence title claims, as well as the health and economic well-being through impacts to drinking water, hunting, fishing, recreation and tourism. Oneida Nation of the Thames, Munsee-Delaware and Chippewas of the Thames First Nation rely on the Thames River as an indirect source of drinking water, sustenance in the way of fish, gathering and harvesting of ceremonial and medicinal plants and recreation. The watershed is an important hunting ground and is essential to archival and oral traditions, history, knowledge and identity.

First Nations Communities with an interest in the One River Master Plan EA include:

- Aamjiwnaang First Nation
- Delaware Nation (Moravian of the Thames)
- Chippewas of the Thames
- Munsee-Delaware Nation
- Oneida Nation of the Thames
- Bkejwanong Territory (Walpole Island)
- Caldwell First Nation
- Chippewas of Kettle and Stony Point First Nation
- Southern First Nations Secretariat
- Metis Nation of Ontario

**3.2.5 Planned Land Use and Infrastructure**

The City is experiencing an increase in population with an approximate 4.8% increase in population growth from 2011 to 2016 (Statistics Canada, 2017). The City anticipated that demographic growth will continue with approximately 77,000 new residents by 2035 (City of London, 2016). Therefore, planned land use and future development will consider the current and future needs of the growing population while managing the available park and recreational resources.

In the past, most urban uses within and adjacent to the Thames Valley Corridor have purposely derived minimal benefit from a 'Thames River address' by developing infrastructure with minimal focus on the corridor (City of London, 2011). Redevelopment presents an opportunity to reverse this and facilitate land uses that are more compatible with the Thames Valley Corridor context of improving the aesthetic value of the urban structure. Planned land use and infrastructure associated with the Thames Valley Corridor will align with desired land uses described in the City's Official Plan (City of London, 2016) including principles to protect and preserve natural features for their integration into the land use design, maintain open views of natural features and landmarks, and the creation of gateways at strategic locations. The public has expressed a strong interest in managing new development adjacent to the Thames Valley Corridor toward these objectives (City of London, 2011).

Strategic restoration of open space lands to buffer and enhance existing remnant natural areas is an important management strategy for the Thames Valley Corridor (City of London, 2011). Providing access to the Thames River's edge for activities such as viewing, fishing, or exploring nature is anticipated to support river users who have expressed concern regarding the Thames River's stewardship and restoration efforts. Creating strategic access points along the Thames River is important to limiting unplanned trail development by the public as well as preventing the destruction of existing riverbank vegetation.

The City also plans to develop programming along the Thames Valley Corridor to allow for festivals, events and activities that will facilitate social connections, physical health, mental well-being and intellectual development (City of London, 2016).

The existing parks and open space system should continue to support areas where people and nature can co-exist in the same ecosystem. For example, additional benches, rest areas, shade trees, washrooms and drinking fountains should be developed at strategic locations for ongoing enjoyment. The creation of secondary pathways and/or trail connections should focus on neighbourhoods with socio-demographic indicators that suggest access to no/low-cost or unstructured outdoor recreation opportunities would be most beneficial. Limitations on development and land use activities within the Thames Valley Corridor are imposed by the natural flood plain, slope and erosion hazard areas; however, restoring, rehabilitating and enhancing natural heritage areas subject to flooding or erosion hazards (such as, the Thames Valley Corridor) is one of the City's highest priorities (City of London, 2016). Additionally, the Thames Valley Corridor Plan (City of London, 2011) is a progressive step to ensure London's natural heritage assets are protected and preserved, while enhancing recreational opportunities. Refer to Appendix A-8 to find the strategic planning review for the One River study area.

### **3.2.6 Back to the River Design Integration**

The Back to the River "Ribbon of the Thames" award-winning design incorporates a number of elements that support a River vision that has been called bold and exciting. It focused on bringing people back to the River to enjoy a significant cultural and heritage resource and engage in activities that reflect the river's beauty and cultural significance. The One River EA project team and the Civitas/Stantec team has coordinated throughout the EA on integrating components of the Ribbon of the Thames into the EA evaluation and adapting the design to future water levels. The design elements of the Ribbon of the Thames have been integrated in the evaluation of alternatives for the Forks in Stage 2 of the One River EA.

### **3.2.7 Springbank Dam**

The original Springbank Dam was built in the 1870s as a water reservoir at a different location than the current dam. The dam failed at various times over the few decades and there was no dam in operation from 1917 to 1929.

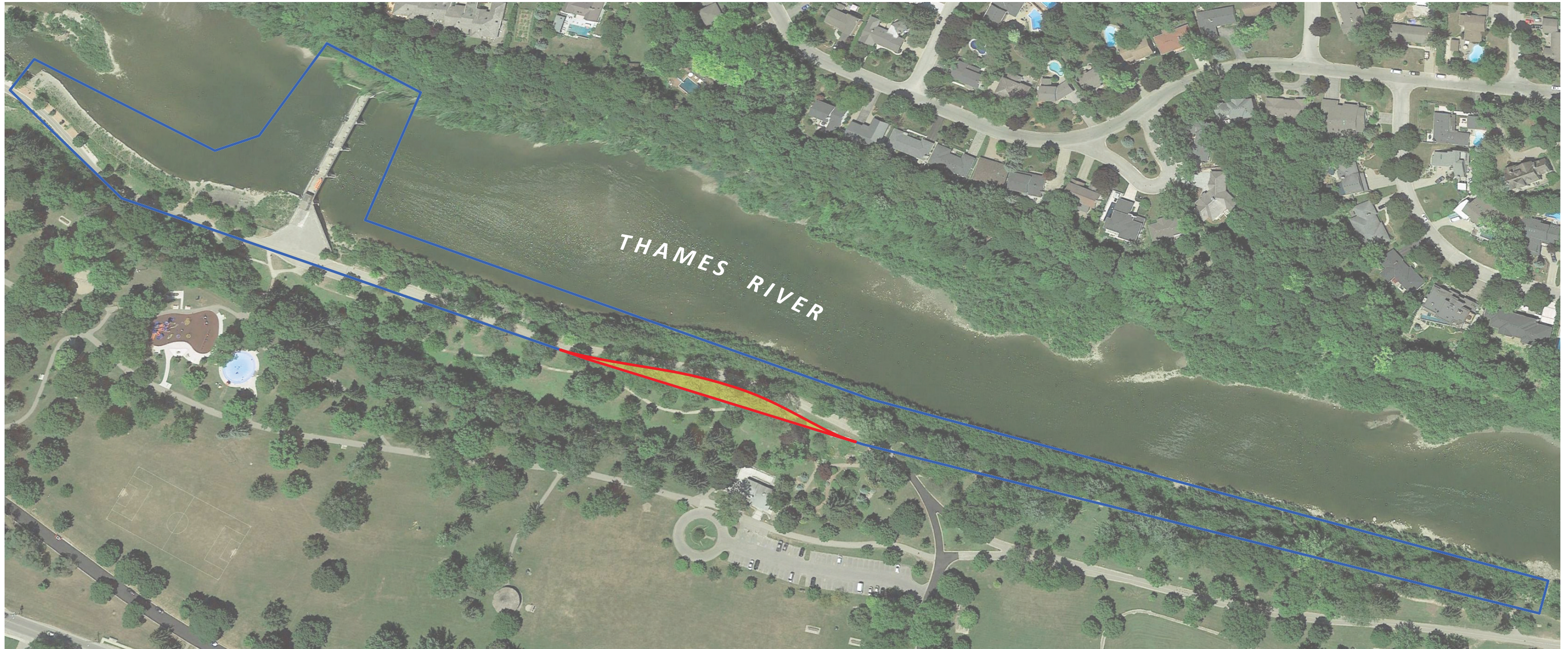
The current location was the site of construction for the next Springbank Dam structure in 1929. This dam was again built to provide a water reservoir and to support recreational opportunities along the river. The dam, when operational, raised water levels in the Thames upstream of the dam to the forks of the Thames area in downtown London and provided deeper water for recreation and access to the river. Typical operation of the dam was from late May and then opened again in early November. The dam is owned by the City of London and was operated by the UTRCA (UTRCA, 2015a).

The 1929 structure consisted of four main bays separated by concrete abutment or pier walls. The main bays were split into five sub bays. The structure included concrete elements or concrete encased steel beams, in the case of the deck framing between concrete foundation elements.

The dam underwent a significant rehabilitation project in 1968. Shotcrete facing was added to the existing superstructure pier walls and exposed abutment walls. A sheet pile wall was constructed on the upstream embankment on the southern bank and a concrete crib wall was added on the northern bank upstream and downstream of the right abutment.

In 2000, a debris field that flowed down the river during an extreme rainfall event damaged the dam. A review of the dam condition at that time resulted in recommendations to rehabilitate the dam to meet current safety standards. In 2008 during the testing of the new dam a failure occurred, and the dam has not operated since. The dam was not designed to provide any flood attenuation.

While in use, the dam structure was inspected every 10 years with the most recent inspection occurring in 2011. In 2018, an assessment of the condition of the dam structure and components was performed to support the development of the One River Master Plan EA, specifically to support the Stage 2 alternatives evaluation. The memorandum summarizing the findings of the 2018 condition report can be found in Appendix A-6. This inspection found that the concrete elements exposed to a fluctuating water line are the most vulnerable and recommended concrete repair occur in the next 5 to 10 years to prevent further deterioration.



Source (Golder, 2019b)

LEGEND

- Dam Decommissioning  
Schedule B EA Study Area
- Identified Pre-Contact  
Indigenous Site

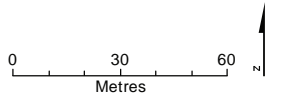


Figure 3-11. Archaeological Studies Pre-Contact Indigenous Site on South-eastern Boundary of the Study Area  
One River EA  
City of London  
London, Ontario